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ABSTRACT

This seminar paper discusses the enormous economic benefits of investing in women's education. Over time increases in girls' education have the potential to transform societies. Four conclusions were reached: (1) the excess female mortality in many developing countries is a horrifying problem that is the most obvious manifestation of a much broader problem of female deprivation; (2) female deprivation results from a vicious cycle where girls are not educated because they are not expected to make an economic contribution to their families, an expectation that represents a self-fulfilling prophecy; (3) increasing educational opportunities for girls offers the best prospect for cutting into this vicious cycle because increasing outlays directed at educating girls would yield enormous economic and social benefits; and (4) the share of the world's girls who go to school can be increased at a relatively modest cost, and over time have the potential to transfer the society. The best way to achieve increased investment in the education of girls is: (1) provide schools for girls; (2) make educating girls more economically attractive by reducing labor market discrimination against women and reducing the costs to parents of sending their daughters to school; and (3) design schools for girls in a way that is consistent with cultural values. Because education is a labor-intensive business, it is relatively inexpensive to provide in low-income countries. Letting girls go to school, learn to read, and experience more of the world beyond their homes makes them better off immediately and enriches their families. (DK)

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Economic Development Institute
of The World Bank

Investing in All the People

Educating Women in Developing Countries

Lawrence H. Summers

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Investing in All the People

Educating Women in Developing Countries

Lawrence H. Summers

This EDI Seminar Paper was originally delivered as a presentation in a Development Economics Seminar at the 1992 Annual Meeting of The World Bank.

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Foreword

Investment in human capital is a key element in achieving long-term sustainable economic growth. Macroeconomic studies have shown that education is positively correlated with overall economic growth, with one year of additional schooling of the labor force possibly leading to as much as a 9 percent increase in GDP for the first three years of schooling and to 4 percent a year for the next three years.

EDI offers seminars that deal with issues concerning the education of girls. These seminars examine policy alternatives that have been tried in various countries. This paper, which was originally presented by Lawrence H. Summers as a speech at the World Bank's annual meeting in 1992, discusses the enormous economic benefits of investing in women's education. The author suggests that, over time, increases in girls' education have the potential to transform societies.

EDI will provide one set of overhead transparencies of the figures used in this document to training or academic institutions that deliver courses or seminars on this topic. To obtain a set, write to the EDI Training Materials Resources Center, M-P1-010, 1818 H Street, N.W., Washington, D.C., 20433, or fax your order to (202) 676-1184.

Amnon Golan
Director
Economic Development Institute

Acknowledgments

This speech builds on work done by many others at the World Bank and elsewhere whom I would like to thank.

Ann Hamilton's Population and Human Resources Department (PHR) produced most of the research reported here, and I would like to thank her for her efforts, insights, and patience, as well as for facilitating interactions with her staff.

Barbara Herz, Chief of the Women in Development Division of PHR, and her staff have contributed tremendously to this presentation. I borrowed freely from her paper "Letting Girls Learn," as well as from a draft paper by K. Subbarao and Laura Raney, "Social Gains from Female Education: A Cross National Study." Guilherme Sedlacek, Reema Nayar, and Agnes Quisimbing surveyed and summarized the relevant research literature and graciously provided household survey results from Brazil.

I would like to thank Elizabeth King of the Education and Employment Division of PHR for her help and comments. Many of the themes of this presentation are drawn from the book edited by Elizabeth King and M. Anne Hill and published by the Johns Hopkins University Press, *Women's Education in Developing Countries: Barriers, Benefits, and Policies.*

Adriaan Verspoor, Chief of the Education and Employment Division, and his staff did their best to enlighten me on

the intricacies of education policy. Elizabeth King, Richard Bennett, and Chris Thomas helped with the costs of schooling.

Mead Over of the Population, Health, and Nutrition Division of PHR brought to my attention his work on women's education and AIDS in Africa and provided his original data.

Kathy Rosen of the Bank's Art and Design Division produced all the figures for the presentation with extraordinary speed and skill.

I also would like to thank Harold Alderman, Nancy Birdsall, Susan Cochrane, and T. Paul Schultz for useful comments and discussion.

Lawrence H. Summers

Investing in All the People

I decided to speak today on "Investing in All the People" because an extensive body of recent research conducted at the World Bank and elsewhere has convinced me that once its benefits are recognized, investment in girls' education may well be the highest return investment available in the developing world.

Girls' education may seem an odd topic for an economist to address, but economics, with its emphasis on incentives, provides a useful way to understand why so many girls are deprived of education and employment opportunities. Concrete calculations demonstrate the enormous economic benefits to investing in women. I would dare to suggest that over time, the importance of female education will dwarf all of the financial issues on which we will focus during the next few days.

In my presentation today, I will reach four conclusions.

First, the excess female mortality in many developing countries is a horrifying problem. It is the most obvious manifestation of a much broader problem of female deprivation.

Second, female deprivation results from a vicious cycle where girls are not educated because they are not expected to make an economic contribution to their families; an expectation that represents a self-fulfilling prophecy.

Third, increasing educational opportunities for girls offers the best prospect for cutting into this vicious cycle. Increasing

outlays directed at educating girls would yield enormous economic and social benefits.

Fourth, the share of the world's girls who go to school can be increased at a relatively modest cost. Over time, increases in girls' education have the potential to transform societies.

The Female Deprivation Problem

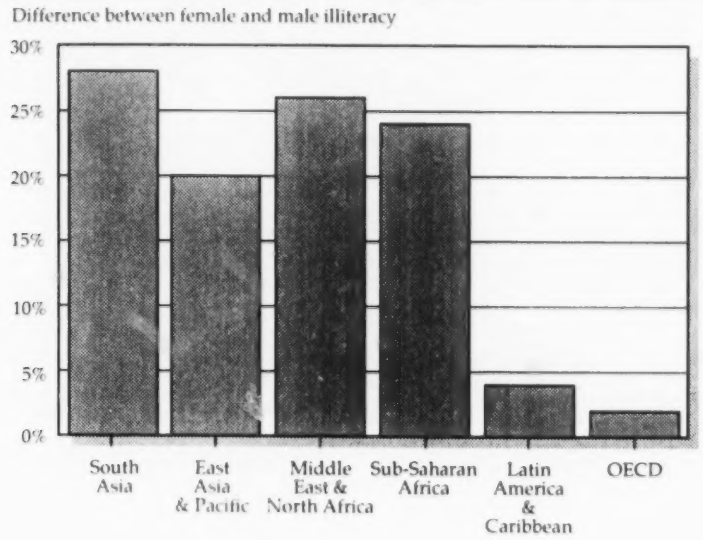
Perhaps the most dramatic indicator of the special problems women face comes from the most basic of all national statistics: the population's demographic composition. One might expect that the proportion of the population that is female in a country would be a biologically determined constant. Yet there are large differences around the world in the fraction of the population that is female. While women comprise 52.5 percent of the population in the industrialized world, they constitute 51 percent of the population in Sub-Saharan Africa, less than 48 percent in East Asia, and less than 47 percent in South Asia.

My Harvard colleague Amartya Sen has calculated from numbers of this type that more than 100 million women are "missing" worldwide, and has described the fate of these women as "one of the more momentous problems facing the contemporary world." While some of the differences in the female composition of the population may be caused by census biases and the effects of migration, the overwhelming reason why 100 million women are missing is their excess mortality. In industrialized countries, where basic necessities are available to all, women outlive men by an average of six

years. Due to excess female mortality, the spread is lower in many developing countries. In large parts of South Asia men live longer than women.

Differential mortality of women and girls is just the most dramatic manifestation of systematic discrimination. Women and girls are more likely to be impoverished than men and boys. Studies have even found evidence that girls are fed less than their brothers and that their illnesses are less likely to be treated than those of their male siblings. Thus, it can come as no surprise that female literacy falls far short of male literacy (figure 1).

Figure 1. Women's Illiteracy Greatly Exceeds Men's



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The Vicious Cycle of Deprivation

No simple explanation exists for the extent of female deprivation or its variation across time and space. Poverty does bear down especially hard on women, but it is striking that despite very high poverty rates, the problem of excess female mortality is much less severe in Africa than in South Asia.

Cultural factors must surely play some role in explaining differences in the extent of female deprivation, but this type of explanation does not point to policy levers for reducing female mortality. In addition, it cannot be fully adequate given that the female fraction of the population has changed substantially in some countries, but not in others. Sri Lanka, for example, has made great progress, while more than a dozen other nations have a lower percentage of women in the population than they had fifteen years ago.

The most fruitful way to understand deprivation is both as a consequence and a cause of a vicious cycle, whereby parents fail to invest in their daughters because they do not expect their daughters to be able to make an economic contribution to the family, and the prophecy turns out to be self-fulfilling. Two stories illustrate the nature of this cycle.

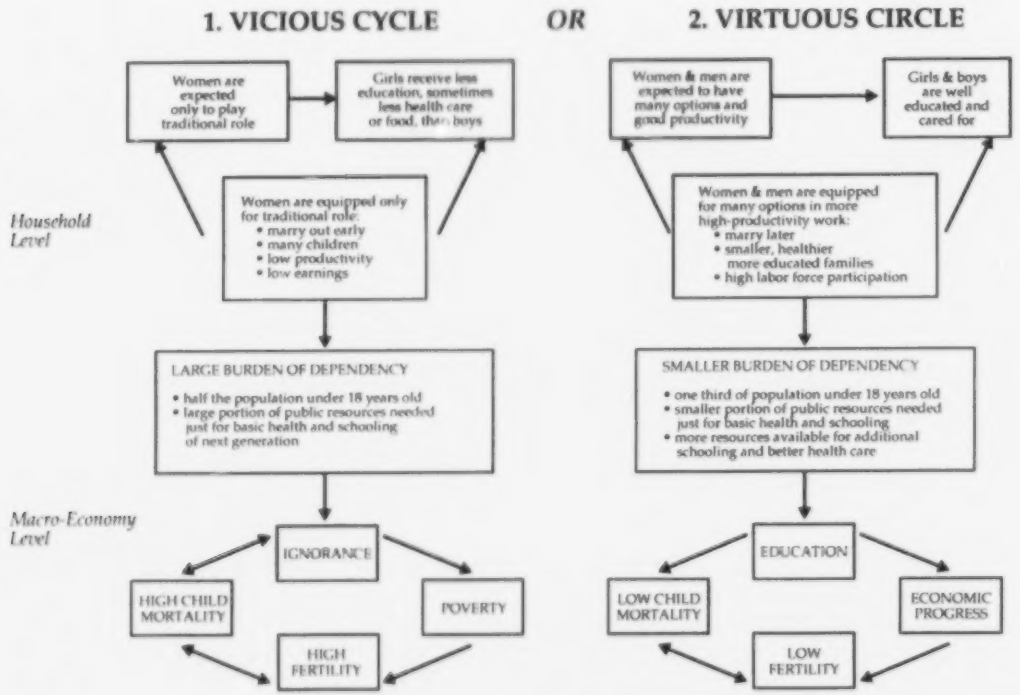
Situation A. A poor family has six children. The mother never attended school, was married at age fifteen, and remains illiterate. She works in the fields even though she is seven months pregnant. Her husband earns most of the family's meager income and decides how it is spent. As he, not his sisters, is expected to support his parents, he recognizes that

his economic security depends on his sons' ability to support him in his old age. He insists that the boys go to school while the girls remain at home to do chores. When his daughter becomes mysteriously ill, he feels that he cannot afford to go with her for two days to the medical clinic in the city. His wife pleads with him, but he will not change his mind, repeating the words, "We have to think about our future." The wife finally relents, realizing that he is right. The daughter dies.

Situation B. A poor family has three children. The mother went to school for five years and is able to read and do arithmetic well enough to teach school in the village. As her last birth was extremely difficult, she and her husband adopted family planning. This allows her more time and resources to spend on her family. She visits her ill mother often and buys her medicine. She insists that all her children go to school and practice their reading each night, hoping to expand their horizons. When one of her daughters gets sick and does not seem to be getting better, she takes her to the medical clinic. The doctor gives the mother some ampicillin tablets and instructs the mother to give them to any of the children who fall ill. The daughter's strep infection is cured, as is the infection of the son who was running a high fever by the time the mother returned home.

These two stories illustrate the alternatives. When girls are not educated, their labor has little economic value outside the home. They are forced to marry young and unable to stand up to their husbands. They have more children than they really want and are unable to invest heavily in each child. Poverty is perpetuated (figure 2).

Figure 2. From Vicious Cycle to Virtuous Circle


1. VICIOUS CYCLE
OR
2. VIRTUOUS CIRCLE
Women are expected only to play traditional role
Girls receive less education, sometimes less health care or food, than boys
Women & men are expected to have many options and good productivity
Girls & boys are well educated and cared for
Household Level
Women are equipped only for traditional role:
• marry out early
• many children
• low productivity
• low earnings
Women & men are equipped for many options in more high-productivity work:
• marry later
• smaller, healthier more educated families
• high labor force participation
LARGE BURDEN OF DEPENDENCY
• half the population under 18 years old
• large portion of public resources needed just for basic health and schooling of next generation
SMALLER BURDEN OF DEPENDENCY
• one third of population under 18 years old
• smaller portion of public resources needed just for basic health and schooling
• more resources available for additional schooling and better health care
Macro-Economy Level
IGNORANCE
HIGH CHILD MORTALITY
POVERTY
HIGH FERTILITY
EDUCATION
LOW CHILD MORTALITY
ECONOMIC PROGRESS
LOW FERTILITY

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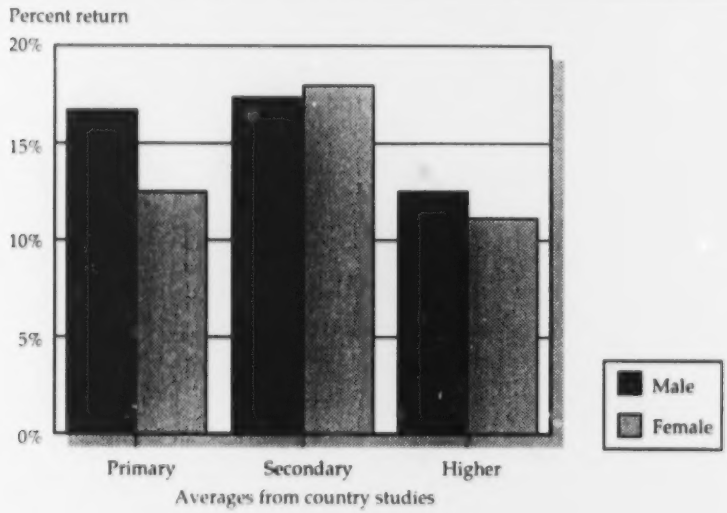
When girls are educated, they have economic opportunities. Their families have more of a stake in their survival and their success. They marry later and are able to take part in household decisions. They choose to have fewer children and can invest more in the health and development of each child. Their daughters and sons have expanded horizons, and often they escape from poverty.

The Solution: Educating Girls

Educating girls offers the best hope of cutting into the cycle of female deprivation. When one takes into account all its benefits, educating girls yields a higher rate of return than any other investment available in the developing world (figure 3).

Figure 3. Private Returns to Educating Females are High at All Levels



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Consider the benefits.

Most obviously, educating women raises their productivity. A huge body of econometric evidence from many countries has evaluated the impact of increased schooling on workers' wages. The evidence is that the returns in the form of higher wages are fairly similar for men and women. As a rough approximation, wages increase by more than 10 to 20 percent for each additional year of schooling.

Returns of this magnitude are impressive by the standard of other available investments, but they are just the beginning of the benefits from increasing female education. In part because of what women do with the extra income they earn, in part because of the extra leverage it affords them within the family, and in part because of the direct effects of being more knowledgeable and aware, female education has an enormous social impact. While the evidence is that increased schooling of boys and girls is similar in its wage impact, educating girls is clearly much more effective in generating social benefits. Educating girls yields nonpecuniary benefits in five areas.

First, educating women reduces child mortality (figures 4, 5). The evidence that mothers channel much more of their income to expenditures on children than their husbands do is overwhelming. Education also increases the willingness to seek medical care and improves sanitation practices. Small wonder that the children of more educated women are much more likely to grow up healthy.

Figure 4. Educating Women Reduces National Infant Mortality

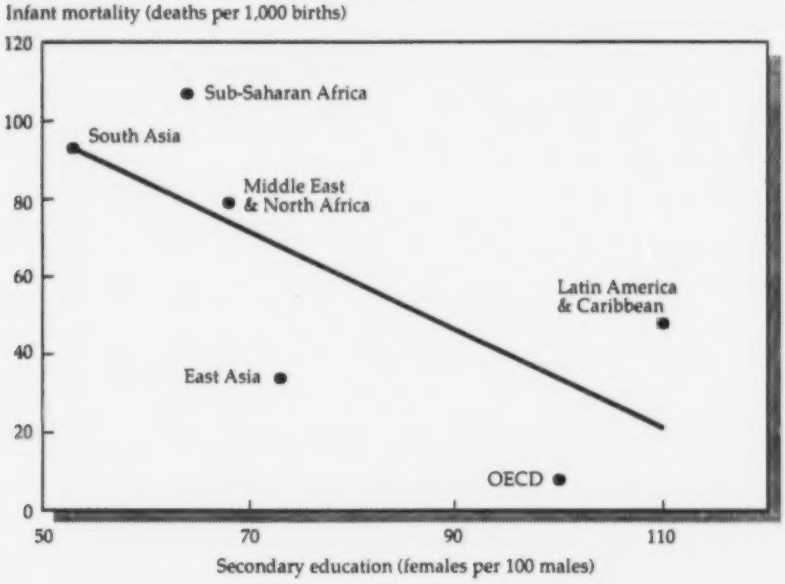
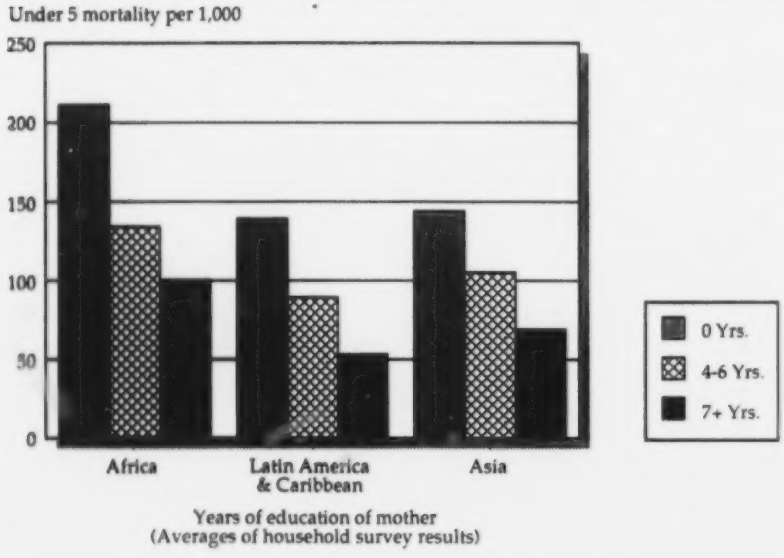


Figure 5. Educated Women Have Healthier Children



This relationship is apparent from comparisons of female education rates across regions, even after statistical techniques are used to hold variables such as income levels and male schooling constant. Studies done at the micro level within individual countries also show that more educated women have healthier children. In Africa, for example, the child of a woman who has not been to school has a one in five chance of dying before reaching the age of five; a child whose mother attended five years of school has a mortality risk that is over 40 percent less; and a child whose mother has attended seven years of school has a mortality risk that is more than 50 percent less.

Second, educating women reduces fertility (figures 6, 7). Educated women want to have fewer children and are better able to attain their desired level of fertility. In regions where female education levels are higher, fertility levels are lower; a pattern that continues to hold when a wide variety of country characteristics are held constant. Econometric studies within individual countries find that an extra year of female schooling reduces female fertility by approximately 5 to 10 percent.

Third, educating women reduces maternal mortality (figure 8). A final group of beneficiaries of investments in female education is women themselves. Maternal mortality rates are ten times as high in South Asia as in East Asia. By increasing knowledge about health care practices and reducing the average number of pregnancies, female education significantly reduces the risk of maternal mortality. Based only on the impact on the number of births, and not including what are surely significant impacts on the risks associated with any

Figure 6. Educating Women Reduces National Fertility Rates

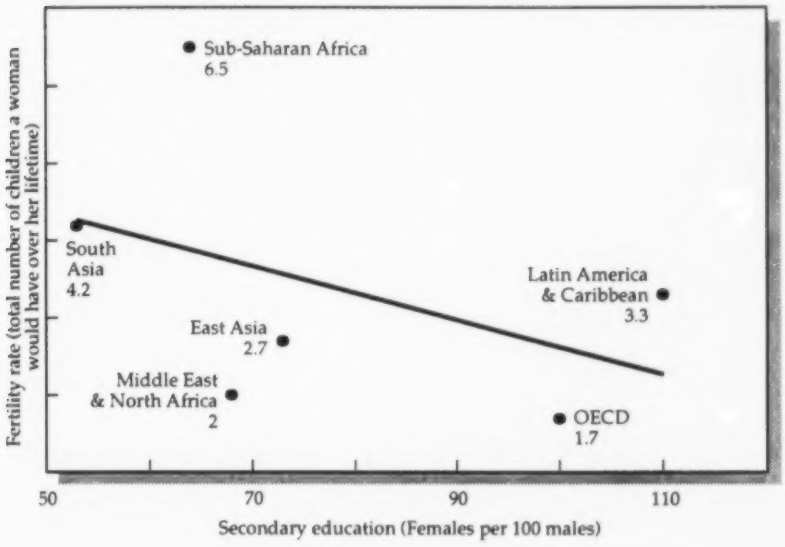


Figure 7. Educated Women Have Fewer Children

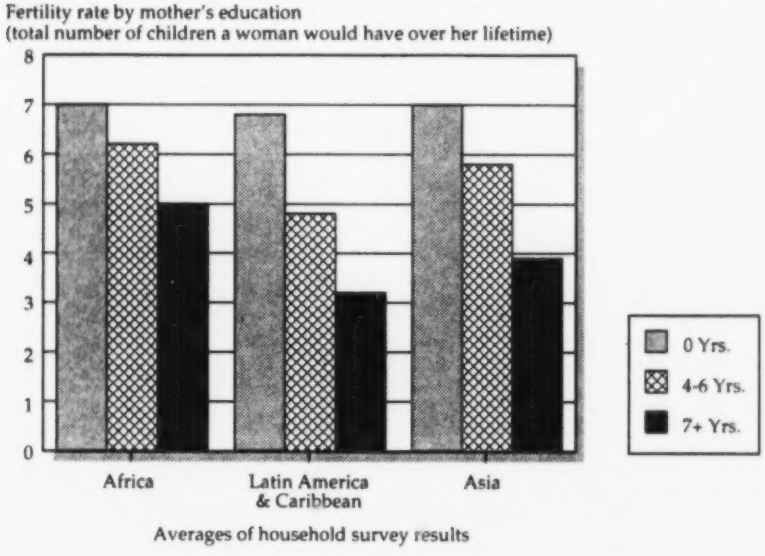
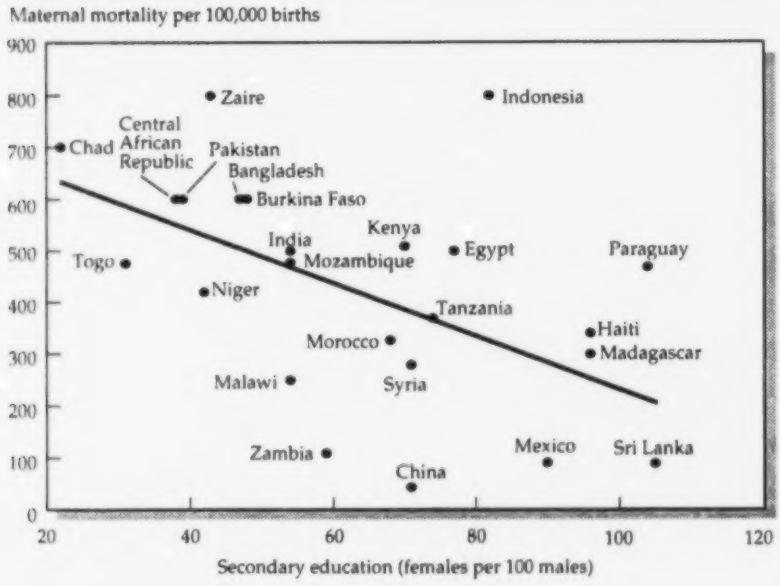


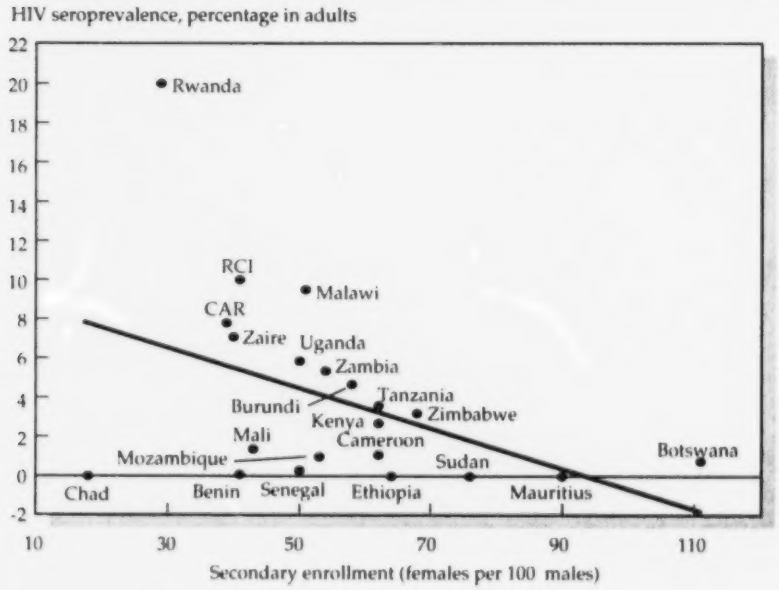
Figure 8. Educating Women Reduces National Maternal Mortality



given birth, one can calculate that an additional year of schooling for 1,000 women will prevent two maternal deaths.

Fourth, educating women helps prevent the spread of AIDS (figure 9). One of the main conclusions that came out of the recent international conference on AIDS in Amsterdam was the importance of empowering women in the control of the disease. Educated women are more likely to enter into stable marriages and look out for their reproductive health, and much less likely to become prostitutes. Each of these factors is crucial in stopping the spread of AIDS. The contribution that educating women can make to AIDS control is suggested by data indicating that educated women reduce HIV prevalence

Figure 9. Educated Women Reduce HIV Prevalence in Urban Africa



in urban Africa. In urban Zaire, for example, where only 28 percent of secondary school students are female, over 7 percent of adults are HIV positive. By contrast, in urban Zimbabwe, where over 40 percent of students enrolled in secondary school are female, HIV prevalence in adults is under 4 percent.

Fifth, educating women has important environmental benefits. This year's *World Development Report* concluded that investment in female education is one of the highest return investments in environmental protection that developing countries can undertake, and included it in its package of environmental imperatives for the 1990s. Educating women contributes to reduced fertility. By raising the opportunity cost of women's

time, it discourages them from clearing forests, and it increases their ability to manage natural resources efficiently.

How can these estimates of the social benefits of increasing girls' education be put in terms where comparisons with other investments are possible? No one can objectively value a life saved or put a price tag on empowering women, but I think a crude calculation is instructive.

For two countries, India and Kenya, I have estimated the cost of educating 1,000 girls for one additional year (figure 10). Then I have tried to estimate how much it would cost to produce similar health and fertility benefits using standard

Figure 10. Calculation of Net Social Benefits for Representative Countries

	India	*Kenya*
Cost of one additional year of primary schooling, for 1,000 women	$32,000	$58,000
Benefits of an additional year of schooling:		
Child mortality reduced by:	7.5%	7.5%
Alternative cost per child death	$750	$750
Total value of averted infant deaths	$32,000	$36,000
Births averted:		
Percentage reduction in total fertility rate	7.5%	7.5%
Alternative cost per birth averted	$250	$300
Value of averted births	$75,000	$98,000
Maternal mortality:		
Maternal deaths averted	2	2
Alternative cost per averted maternal death	$1,500	$1,500
Value of averted maternal deaths	2,300	2,600
Discounted social benefits (15 years, 5%)	$52,000	$66,000

medical and family planning interventions. The results are striking. In India, providing 1,000 girls with an extra year of primary schooling would cost US$32,000. It would avert two maternal deaths, forty-three infant deaths, and 300 births.

Even after discounting to take account of the time lag between when girls are educated and when they grow up and have children, the social benefits of educating girls are enough to cover the costs without taking any account of the market return or the benefits for environmental protection and AIDS control. I have also neglected the add-on benefits as the daughters of better educated mothers are likely to have healthier and better educated children. When the average woman has about forty grandchildren, as in much of Africa, this is no small thing.

Educating More Girls

The case for increased investments in the education of girls is overwhelming. What is the best way to achieve this?

First, much can be accomplished simply by providing schools for girls. A survey in Pakistan found that the largest single reason girls gave for not enrolling in school was "there is no school for girls." Another recent survey of Pakistani households found that in villages with girls schools, primary school enrollments were nearly equal for girls and boys, but that enrollment lagged badly in villages without nearby girls schools. This implies that the lack of village schools and not cultural inhibitions is the single most important reason for the low rate of female enrollment in Pakistani schools.

Second, educating girls must be made more economically attractive. This means reducing labor market discrimination against women. It also means reducing the costs to parents of sending their daughters to school. As the social benefits of educating girls are greater than for boys, it is appropriate for females' education to cost less than males' education. A study in Peru found that rules requiring students to pay for textbooks had a large negative effect on female enrollment, but almost no effect on male enrollment. Scholarship funds should be established and more free books and other supplies provided for girls.

Third, schools for girls must be designed in a way that is consistent with cultural values. Female enrollment depends heavily upon schools not being too far away, upon the provision of appropriate sanitation facilities, and upon the hiring of female teachers. This, of course, is facilitated by raising female enrollment rates. Flexible hours and the provision of care for younger siblings can also be helpful in some cases.

As the largest single source of external funding for education, the World Bank is committed to increasing the number of girls who have an opportunity to go to school. The Bank's lending for education has more than doubled in recent years to nearly US$2 billion a year. As of the next fiscal year, the vast majority of its education loans will contain explicit support for steps to increase female enrollment.

For example, a current rural education project in Morocco is constructing schools closer to target communities to encourage female attendance, providing free textbooks, and desig-

nating half of all school boarding facilities and scholarships for female students. In Mali, an ongoing project provides for basic principles of health, nutrition, and child care to be added to the curriculum to overcome parents' reluctance to send their daughters to school. In Bangladesh, where only 20 percent of the current teaching force is female, 60 percent of the newly hired teachers will be female under a Bank-assisted project and scholarships will be established specifically for girls.

Because education is a relatively labor-intensive business, it is relatively inexpensive to provide in low-income countries. The available statistics indicate that in low-income economies, the average annual recurrent costs of primary schooling (which constitute the vast majority of the costs) run slightly over US$36 per student. Secondary education is somewhat more expensive because of the need for more skilled teachers and more sophisticated teaching aids.

Raising the female primary school enrollment rate to equal the male primary school enrollment rate in developing countries would involve educating an additional 26 million girls each year at a total cost of approximately US$1 billion (figure 11). Raising the secondary school enrollment of girls to equal the secondary school enrollment rate of boys would involve educating an additional 32 million girls at a total cost of US$2.2 billion. Eliminating educational discrimination in the developing world would thus cost a total of US$3.2 billion annually. This represents less than one quarter of 1 percent of developing countries' GDP, less than 2 percent of their government

Figure 11. Cost of Equalizing Female and Male Enrollment

Primary	*# of students (millions)*	*US$ cost (millions)*
Low-income countries	25	930
Low-income countries (w/o India, China)	6	230
Middle-income countries	5	70
All developing countries	26	1,000
Secondary		
Low-income countries	29	1,500
Low-income countries (w/o India, China)	6	700
Middle-income countries	3	700
All developing countries	32	2,200

consumption, and less than 1 percent of their total investment in new capital goods.

Considering the very low cost of equalizing educational opportunities for men and women, the question is not whether countries can afford this investment, but whether countries can afford not to educate more girls. Current projections suggest that developing countries will spend approximately US$1 trillion on power plants during the next ten years. Yet in many of these nations, existing power plant capacity utilization is less than 50 percent due to poor maintenance and pricing problems. It is hard to believe that building twenty-nine out of every thirty planned power plants and using the savings to finance equal educational opportunities for girls would not be desirable.

Conclusion

Letting girls go to school, learn to read, and experience more of the world beyond their homes makes them better off immediately and enriches their families. Over time, getting girls into school can transform societies as their sons and daughters and grandsons and granddaughters reap the benefits.

One set of estimates prepared in the World Bank's Women in Development division suggests that a doubling of female enrollment rates in 1975 in a large sample of developing countries could have averted nearly 4 million childhood deaths: half the total childhood deaths that occurred (figure 12). The same study suggests that nearly 30 million births could have been averted.

Figure 12. The Long-Run Impact of Improved Female Education

	Births Averted Per Year (millions)	*Childhood Deaths Averted Per Year (millions)*
Low and middle-income countries (n=65)	29.6 29%	3.7 49%
Low-income countries (n=31)	25.6 32%	3.55 52%
Sub-Saharan Africa (n=26)	6.1 35%	1.4 67%
South Asia (n=5)	16.2 48%	1.84 58%

Simulated impact of doubling female enrollment in 1975

Lectures and papers that stress the importance of a particular type of investment in developing countries are hardly uncommon. Reflecting the biases of an economist, I have tried to concentrate on the concrete benefits of female education and explicitly contrast it with other investments. Expenditures on increasing the education of girls do not just meet the seemingly easy test of being more socially productive than military outlays. They appear to be far more productive than many other valuable categories of investment.

In making an economic argument for investing in female education, I have tried to steer clear of the moral and cultural aspects unavoidably involved in any gender-related question. Partially this reflects my comparative advantage as an economist, but it also reflects a conviction that helping women be better mothers to their children is desirable whatever one's view of the proper role of women in society.

There are those who say that educating girls is a strategy that pays off only in the long run. I am reminded of a story that John F. Kennedy used to tell of a man asking his gardener how long it would take for a certain seed to grow into a tree. The gardener said it would take 100 years, to which the man replied, "Then plant the seed this morning. There is no time to lose."

Data Sources and Methods

Figure 1: **Women's Illiteracy Greatly Exceeds Men's**. The graph is based on population-weighted regional averages of total and female adult illiteracy in 1990 reported in World Bank, 1992, *World Development Report 1992*, Washington, D.C. (World Development Indicators, table 1).

Figure 2: **From Vicious Cycle to Virtuous Circle**. This figure is taken from B. Herz, *Letting Girls Learn*, PPR Discussion Paper No. 133, 1991, Washington, D.C.: World Bank.

Figure 3: **Private Returns to Educating Females Are High at All Levels**. The figures are averages of the rates of return reported in T. Paul Schultz, 1989, *Women in Development: Objectives, Frameworks, and Policy Interventions*, PPR Working Paper No. 200, Washington, D.C.: World Bank (table 1, p. 43).

Figure 4: **Educating Women Reduces National Infant Mortality**. The source is the world development indicators of the World Bank, 1992, *World Development Report 1992*, Washington, D.C., table 28 for population-weighted regional averages of infant mortality and table 32 for female secondary enrollment per 100 males.

Figure 5: **Educated Women Have Healthier Children**. The graphs use regional averages of figures taken from J. N. Hobcraft, J. W. McDonald, and S. O. Rutstein, 1984, "Socioeconomic Factors in Infant and Child Mortality: A Cross National Comparison," *Population Studies*, volume 38, p. 198 (table 3). Their study summarizes the results on child mortality by mother's education from the World Fertility Survey for twenty-eight countries.

Figure 6: **Educating Women Reduces National Fertility Rates**. The source is the world development indicators of the World Bank, 1992, *World Development Report 1992*, Washington, D.C., table 27 for population-weighted regional averages of total fertility rates and table 32 for female secondary enrollment per 100 males.

Figure 7: **Educated Women Have Fewer Children**. The graph uses the regional averages reported in United Nations, 1988, *Fertility Behaviour in the Context of Development: Evidence from the World Fertility Survey*, New

York, (table 112, p. 225). The study reports total fertility by female education level from the world fertility surveys of thirty countries.

Figure 8: **Educating Women Reduces National Maternal Mortality**. The source is world development indicators of the World Bank, 1992, *World Development Report 1992*, Washington, D.C., table 32 for female secondary enrollment per 100 males and maternal mortality per 100,000 live births (the data are for 1980).

Figure 9: **Educated Women Reduce HIV Prevalence in Urban Africa**. The figure is taken from Mead Over and Peter Piot, "HIV Infection and Sexually Transmitted Diseases," in Dean T. Jamison and others, 1993, *Disease Control Priorities in Developing Countries*, New York, Oxford University Press.

Figure 10: **Calculation of Net Social Benefits for Representative Countries**. The data for this figure come from various sources:

Costs: The cost per student figures are taken from M. E. Lockheed and A. M. Verspoor, 1990, *Improving Primary Education in Developing Countries: A Review of Policy Options*, published for the World Bank, New York, Oxford University Press. From table 20, the public recurrent expenditure per primary student in constant 1985 dollars was the average for 1980 and 1985. The cost figures were updated to 1991 dollars using the U.S. GDP deflator. These figures are compatible with the figures from C. Colclough and K. Lewin, 1990, "Educating all the Children: The Economic Challenge for the 1990s," (unpublished paper presented at the World Conference on Education for All, Bangkok, Thailand) which shows recurrent costs per primary student in low-income countries between US$32 and US$42.

Child mortality: The figure of a 7.5 percent reduction in child mortality per year of primary schooling is based on a number of sources. Cleland and van Ginneken, 1988, "Maternal Education and Child Survival in Developing Countries: The Search for Pathways of Influence," *Social Science and Medicine*, volume 27, issue 2, find that household surveys of differential child mortality rates for a large number of countries are consistent with "an essentially linear relationship between maternal education and childhood mortality, with an average of 7-9% declines in mortality ratios with each one year increment in mother's education." This is consistent with other econometric evidence.

Fertility: Three sources are available for reductions in fertility by level of maternal education. A summary of twenty-nine household surveys by the United Nations, 1988, *Fertility Behaviour in the Context of Development: Evidence from the World Fertility Survey*, shows the total fertility rate (TFR) is, on average, 20 to 40 percent lower among women with education of four to six or seven plus years compared to zero education. Econometric studies using household survey data give various findings. De Tray, 1972, finds an elasticity of -.3, Schultz, 1991, finds an additional year of schooling in Thailand reduces fertility by 7 to 9 percent, Herz and Khander, 1991, *Women's Work, Education, and Family Welfare in Peru*, World Bank Discussion Paper 116, Washington, D.C.: World Bank, find an additional year of schooling in Peru reduces fertility by 6.7 percent. K. Subbarao and L. Raney, 1992, *Social Gains from Female Education: A Cross National Study*, Washington, D.C.: World Bank, use cross-country data to find an elasticity between female enrollment (lagged ten years) and TFR of -0.4, implying an increase in mean years of schooling of one year from four to five years would decrease fertility by 8 percent.

Health costs: Information on the costs of saving lives with various interventions is found in Dean Jamison and others, 1993, *Disease Control Priorities in Developing Countries*, which provides information on the cost per discounted healthy life year saved (DHLY) for a wide variety of possible child and adult health interventions. The calculation assumes that for child deaths the marginal health intervention is oral rehydration therapy at US$25 per DHLY, which translates into US$750 per death averted. For maternal deaths the cost of antenatal and delivery care was estimated at US$150 per DHLY or US$1,575 per averted death.

Cost per averted birth: Nancy Birdsall, 1992, *Another Look at Population and Global Warming*, PRE Working Paper No. 1020, Washington, D.C.: World Bank, gives figures for cost per averted birth in low-income Africa of US$259 and in India of US$213 (1987 dollars). These are based on the calculations of S. Cochrane and F. T. Sai, 1991, "Excess Fertility," who calculate the cost of an averted birth through family planning expenditures based on costs per couple year of contraception and the fraction of women currently wishing to limit the number of births. The U.S. GDP deflator was used to figure 1991 dollars.

Figure 11: **Cost of Equalizing Female and Male Enrollment**. The data for this calculation come from various sources:

Costs: The costs for primary education are recurrent costs per student, taken from Lockheed and Verspoor, 1990, *Improving Primary Education in Developing Countries: A Review of Policy Options*, (table 20). Secondary school costs per student were calculated for fifty-eight countries using data from UNESCO, changing local currency recurrent expenditure per student into dollars at the official exchange rate (IMF IFS line rf), and then moving all figures to 1985 U.S. dollars using the U.S. GDP deflator and taking the average for 1980-89. For countries for which secondary school cost data were not available, we assumed that secondary costs were twice primary costs for middle-income countries and three times primary costs for low-income countries. These ratios are based on comparisons of countries using UNESCO data for both primary and secondary education. C. Colclough and K. Lewin, 1991, "Educating all the Children: The Economic Challenge for the 1990s," (unpublished paper presented at the World Conference on Education for All, Bangkok, Thailand) calculates a ratio of secondary to primary costs of 2.4. Data drawn from World Bank project appraisal reports show a median ratio of primary to secondary school costs of 2.3, although with some very high ratios in African countries with low secondary enrollment.

Enrollment rates and population: These data were drawn from UNESCO and assume a six-year secondary education cycle.

Figure 12: **The Long-Run Impact of Improved Female Education**. These simulations are drawn from an empirical model relating female education to infant mortality and fertility in K. Subbarao and L. Raney, 1992, *Social Gains from Female Education: A Cross National Study*, Washington, D.C.: World Bank, (tables 5 and 6).

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